Networking Working Group
Request for Comments: 2

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1 LINKS

1a Control Links

1a1 Logical link 0 will be a control link between any two HOSTs on the network

1a1a Only one control link may exist between any two HOSTs on the network. Thus, if there are n HOSTs on the network, there are n-1 control links from each HOST.

1a2 It will be primarily used for communication between HOSTs for the purposes of:

1a2a Establishing user links

1a2b Breaking user links

1a2c Passing interrupts regarding the status of links and/or programs using the links

1a2d Monitor; communication

1a3 Imps in the network may automatically trace all messages sent on link 0.

1b Primary Links

1b1 A user at a given HOST may have exactly 1 primary link to each of the other HOSTs on the network.

1b1a The primary link must be the first link established between a HOST user and another HOST .

1b1b Primary links are global to a user, i.e. a user program may open a primary link, and that link remains open until it is specifically closed.

1b1c The primary link is treated like a teletype connected over a normal data-phone or direct line by the remote HOST, i.e. the remote HOST considers a primary link to be a normal teletype user.

1b1d The primary link is used for passing (user) control information to the remote HOST, e.g. it will be used for logging in to the remote host (using the remote hosts standard login procedure).

1c Auxilliary Links

1c1 A user program may establish any number of auxilliary links between itself and a user program in a connected HOST.

1c1a These links may be used for either binary or character transmission.

1c1b Auxilliary links are local to the sub-system which establishes them, and therefore are closed when that subsystem is left.

2 MANIPULATION OF LINKS

2a Control Links

2a1 The control link is established at system load time.

2a2 The status of a control link may be active or inactive

2a2a The status of the control lnk should reflect the relationship betueen the HOSTs.

2b Primary Links

2b1 Primary links are established by a user or executive call to the monitor

2b1a The network identification number of the HOST to be linked to must be included in the call

2b1b An attempt to establish more than one primary link to a particular HOST will be regarded as an error, and the request will be defaulted

why?

2b1c Standard Transmission Character Set

2b1c1 There will be a standard character set for transmission of data over the primary links and control links.

2b1c1a This will be full (8 bit) ASCII.

2b1d (getlink) The protocal for establishing a link to HOST B from HOST A lis as follows

2b1d1 A selects a currently unused link to HOSI B from its allocation tables

2b1d2 A transmits a link-connect message to B over link 0.

2b1d3 A then waits for:

2b1d3a- A communication regarding that link from B

2b1d3b- A certain amount of time to elapse

2b1d4 If a communication regarding the link is recieved from

B. it is examined to see if it is:

2b1d4a A verification of the link from B.

2b1d4a1 This results in a successful return from the monitor to the requestor. The link number is returned to the requestor, and the link is established.

2b1d4b A request from B to establish the link. this means that B is trying to establish the same link as A independently of A.

2b1d4b1 If the network ID number of A(Na) is greater than that of B(Nb), then A ignores the request, and continues to await confirmation of the link from B.

2b1d4b2 If, on the other hand, Na<Nb, A:

2b1d4b2a Honors the request from B to establish the link,

2b1d4b2b Sends verification as required,

2b1d4b2c Aborts its own request, and repeats the allocation process.

2b1d4c Some other communication from B regarding the link.

2b1d4c1 This is an error condition, meaning that either:

2b1d4c1a A has faulted by selecting a previously allocated link for allocation,

2b1d4c1b B is transmitting information over an unallocated link,

2b1d4c1c Or a message regarding allocation from B to A has been garbled in transmission.

2b1d4c2 In this case, A's action is to:

2b1d4c2a Send a link disconnect message to B concerning the attempted connection

2b1d4c2b Consider the state of HOST B to be in error and initiate entry to a panic routine(error).

2b1d5 If no communication regarding the link is recieved from B in the prescribed amount of time, HOST B is considered to be in an error state.

2b1d5a A link disconnect message is sent to B from A.

2b1d5b A panic routine is called(error).

2c Auxilliary Links

2c1 Auxilliary links are established by a call to the monitor from a user program.

2c1a The request must specify pertinent data about the desired link to the monitor

2c1a1 The number of the primary link to B.

2c1b The request for an auxilliary link must be made by a user program in each of the HOSTs (A and B).

2c1c If Na > Nb, then HOST A proceeds to establish a link to HOST B in the manner outlined above (getlink).

2c1d If Na<Nb, then A waits:

2c1d1 For HOST B to establish the link (after looking to see if B has already established the corresponding link).

2c1d2 For a specified amount of time to elapse.

2c1d2a This means that HOST B did not respond to the request of HOST A.

2c1d2b The program in HOST A and B should be able to specify the amount of time to wait for the timeout.

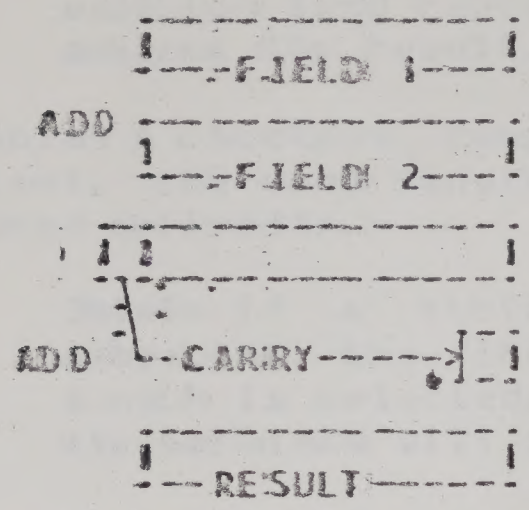
3 ERROR CHECKING

3a All messages sent over the network will be error checked initially so as to help isolate software and hardware bugs.

3b A checksum will be associated with each message, which is order dependent.

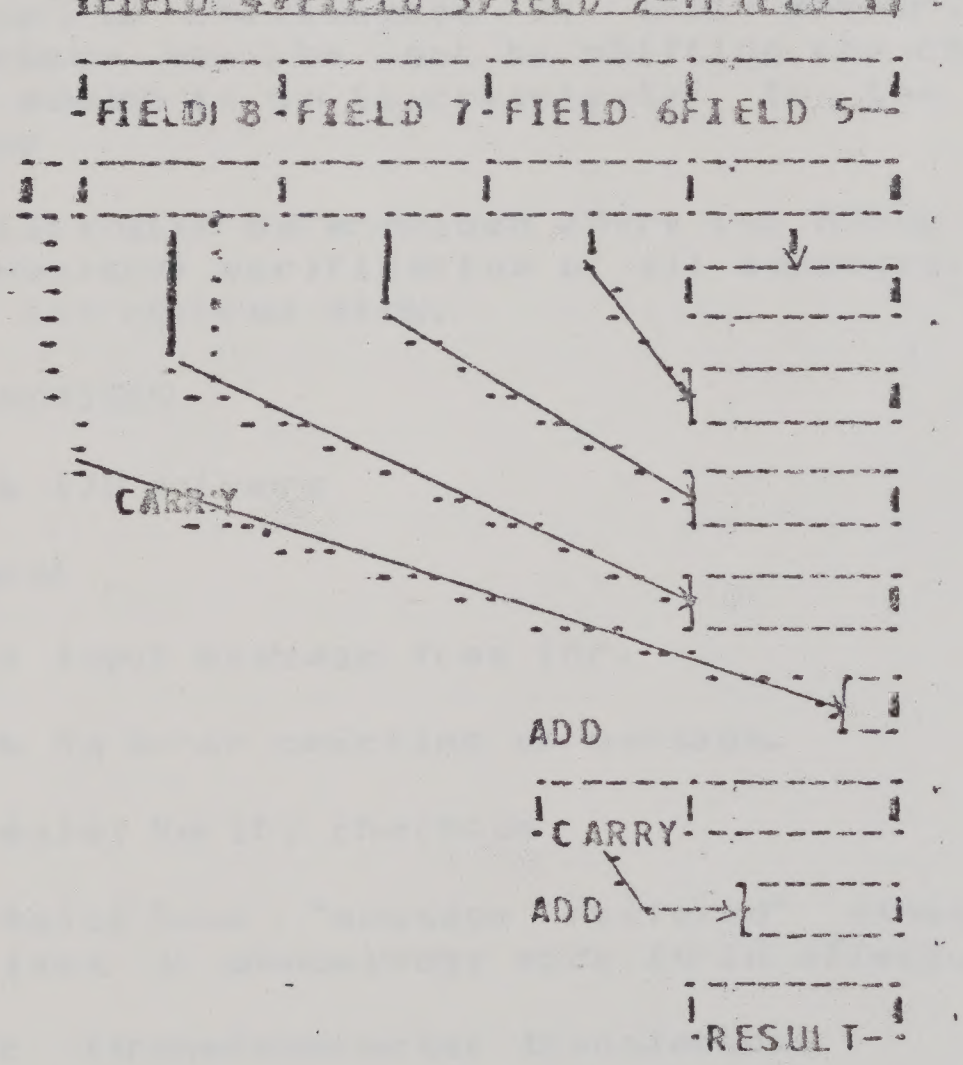
3b1 The following algorithm is one which might be used:

3b1a A checksum of length 1 may be formed by adding successive fields in the string to be checked serially, and adding the carry bit into the lowest bit position of the sum.



3b1a1 This process is known as folding.

3b1a2 Several fields may be added and folded in parallel, if they are folded appropiately after the addition.



3b1a2a Using this scheme, it is assumed that, if there are n fields, the carries from the first n-1 fields are automatically added into the low order position of the

next higher field, so that in folding, one need only add the n results fields to the carry from the nth field, and then add in an appropiately sized carry from that addition (and repeat the desired number of times) to achieve the result.

3b1a3 A checksum computed in this manner has the advantage that, the word lengths of different machines may each be used optimally.:

3b1a3a If a string of suitable length is chosen for computing the checksum, and a suitable checksum field length is selected, the checksum technique for each of the machines will be relatively optimal.

3b1a3a1 Field length: 288 bits (lowest common denominator of (24,32,36)

3b1a3a2 Checksum length: 8 bits (convenient field size for all machines)

3b1b If a message is divided into groups of fields, and each group is checksummed in this manner, an order dependent checksum may be got by shifting the checksum for each group, and adding it in (successively) to the checksum of the next group

3c A facility will be provided where two HOSIs may enter a mode which requires positive verification of all messages. This verification is sent over the control link.

4 MONITOR FUNCTIONS

4a Network I/O drivers

4a1 Input

4a1a Input message from IMP.

4a1b Do error checking on message.

4a1b1 Verify checksum

4a1b2 Send a "message recieved" aknowledgement over control link if aknowledge mode is in effect.

4a1c (trans)character translation.

4a1c1 There is a strong possibility that the character translation may be done in the IMP.

4a1c2 This needs to be explored further with BBN.

4a1c3 There are two main considerations

4a1c3a Should the translation be done by table or algorithm?

4a1c3a1 Initially it seems as though the best way to go is table.

4a1c3b How should we decide which messages should be translated, i.e. is it desirable to not translate everything (YES!!) and by what means can we use to differentiate?

4a1d Decode header, and pass message to correct recipient as identified by source, and link.

4a2 Output

4a2a Build header

4a2b Character translation

4a2b1 See remarks under the section on output translation(trans).

4a2c Create checksum

4a2d Check status of link

4a2d1 If there has not been a RFNM since the last message transmitted out the link, wait for it.

4a2e Transmit message to IMP

4a2f If aknowledge mode is in effect, wait for

4a2f1 RFNM from destination IMP.

4a2f2 Response from destination HOST over control line 0.

4b Network status :

4b1 Maintain status of other HOSTs on network

4b1a If an IMP is down, then his HOST is considered to be down.

4b2 Maintain status of control lines.

4b3 Answer status queries from other HOSTs.

4b4 Inform others HOSTs as to status of primary and auxilliary links on an interrupt basis..

4b5 Inform other HOSTs as to status of programs using primary and secondary links

5 EXECUTIVE PRIMITIVES

5a Primary Links

5a1 These require the HOST number as a parameter.

5a1a Establish primary link

5a1b Connect controlling teletype to primary link

5a1c INPUT/OUTPUT over primary link

5a1d Interrogate status of primary link

5a1d1 don't know what, exactly, this should do, but it seems as though it might be useful.

5a1e Disconnect controlling teletype from primary link

5a1f Kill primary link

5b Auxilliary Links.

5b1 Establish auxilliary link.

5b1a requires the HOST number as a parameter

5b1b It returns a logical link number which is similar to a file index. It is this number which is passed to all of the other Auxilliary routines as a parameter.

5b2 INPUT/OUTPUT over auxilliary link

5b3 Interrogate status auxilliary link.

5b3a don't know what, exactly, this should do, but it seems as though it might be useful.

5b4 Kill auxilliary link.

5c Special executive functions

5c1 Transparent INPUT/OUTPUT over link

5c1a This may be used to do block I/O transfers over a link

5c1b The function of the monitor in this instance is to transfer a buffer directly to its IMP

5c1c At does not modify it in any way

5c1c1 This means that the header and other control information must be in the buffer.

5c1d The intended use of this is for network debugging.

6 INITIAL CHECKOUT

6a The network will be initially checked out using the links in a simulated data-phone mode.

6a1 All messages will be one character in length.

6a2 Links will be transparent to the monitor, and controlled by user program via a special executive primitive..

6a2a The initial test will be run from two user programs in different MOSTs, e.g. DDT to DDT.

6a2b It will be paralleled by a telephone link or similar.